inplate-in glass - not oxide

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(71) Applicant: HOECHST CELANESE CORPORATION [US/US]; 30 Independance Boulevard, Warren, NJ 07059 (US).

(72) Inventors: SUH, Suk, Youn; 22 Quail Run, Warren, NJ 07059 (US). YOON, Hyun–Nam; 88 Colchester Road, New Providence, NJ 07974 (US). TENG, Chia–Chi; 1434 Greenwood Drive, Piscataway, NJ 08854 (US). MALINOSKI, George, L.; 72 Preston Drive, Somerville, NJ 08876 (US).

(74) Agents: GENOVA, John, M. et al.; Hoechst Celanese Corporation, Patent Dept., 86 Morris Avenue, Summit, NJ 07901 (US).

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(54) Title: VIDEO DISPLAY SUBSTRATES WITH BUILT–IN SPECTROSCOPICALLY TUNED MULTI–BANDPASS FILTERS

(57) Abstract

Disclosed in this invention is a spectroscopically tuned display monitor that enhances the contrast, brightness and color space of images from a color display. The monitor comprises suitable absorbing materials in a glass or polymer substrate matrix. Such monitors have utility in devices based on CRTs, plasma displays and the like.

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VIDEO DISPLAY SUBSTRATES WITH BUILT-IN SPECTROSCOPICALLY TUNED MULTI-BANDPASS FILTERS

Field of the Invention

This invention generally discloses spectroscopically tuned articles for video display devices and similar articles. It specifically discloses display substrates with a built-in spectroscopically tuned multiple-band optical filters for the purpose of enhancing the contrast and/or increasing color gamut of images on the screen. The invention disclosed herein is related to that disclosed in pending patent applications, Serial No. 08/ 753,349, filed November 25, 1996, and Serial No. 08/871,575, filed June 9, 1997.

Background of the Invention

Video display devices are nowadays widely used in articles such as televisions, computers, video games and the like. Many of them generally employ a cathode ray tube ("CRT") which is a vacuum tube display device in which the image is created by electrons from an electron gun striking a phosphor screen that converts the electron energy into light energy over a wide wavelength range, usually the visible range for common display devices such as television and computer monitors. The CRT may be monochromatic (single color) or a color display device which produces images in more than one color, typically the three primary colors: red, green and blue.

There are two common problems associated with virtually all types of video displays. The first one is that the true representation of the natural colors ("color gamut") is somewhat limited by the spectral characteristics of the radiation sources used in the color displays. There exists no known device available at the present time to enhance

the color gamut of displays. The second common problem with video display devices is the light reflected from the device towards the viewer, which generally fatigues the viewer's eyes. The reflected light consists of ambient light reflecting off the surface of the screen (which is typically a glass surface) as well as ambient light reflecting off the phosphors behind the screen. Several attempts have been made in the past to avoid or reduce this reflected light.

U.S. Patent 4,989,953, in col. 2, line 13 through col. 3, line 22, describes some of these earlier attempts and the problems associated with them. Most of these attempts, however, have succeeded in reducing the glare from monochromatic display monitors only.

For color displays, earlier attempts to reduce light reflection included, for example, use of a neutral density filter. Neutral density filters or attenuators are designed to produce attenuation that is uniform regardless of the wavelength. See, for example, Jeff Hecht, "The Laser Guidebook," 2nd edition, McGraw-Hill, Inc., New York, 1992, p.79. Such filters comprise colloidal suspensions of silver or graphite particles in a suitable medium and adhered to the monitor surface. This type of filter transmits a fraction of the light passing through it, independent of the wavelengths. These filters, however, have the disadvantage of reducing the brightness of the image. Despite this major disadvantage, neutral density filters are widely used in the manufacturing of current color CRT displays since there is no better alternative.

Another approach has been to use selective filtration by using different colored plates to absorb certain single wavelengths. For example, several single wavelength optical filters are available commercially from Optical Coating Laboratory, Incorporated, Santa

Rosa, California. They, however, suffer the disadvantage that one has to use a different color filter for each phosphor element. Combining several filter materials in order to transmit just the desired red, green and blue generally results in the absorption of some of the desired wavelengths due to cascading of the different filter materials. This reduces the amount of red, green and blue that eventually gets transmitted.

Yet another approach involves a combination of neutral density filter and an antireflection coating. While this cuts down the reflected light, it also reduces the brightness and the resolution of the image.

U.S. Patent 5,121,030 discloses absorption filters which contain a transparent substrate with a plurality of spatially separated areas that contain selective absorptive dye colorants. Since this requires spaced areas with different dye component therein, the construction of the filter is quite complex and difficult to manufacture in large quantities.

U.S. Patent 4,989,953 referred to above advocates the use of colored filters for monochromatic displays. Thus, for example, a magenta colored filter is used for CRTs with green phosphors, and a blue colored filter is used for amber colored CRTs. However, this concept is not much useful for color displays, because the blue filter, for example, will block out the red and/or green depending on the spectral characteristics of the filter. The same problem exists for the other color filters too that the '953 patent discloses. If such filters are used for full color displays, the resulting display color will be severely distorted. For this reason, the '953 patent suggests that a neutral density or gray colored filter must be used for multi-color or black and

white displays. However, this approach, as stated before, reduces the brightness of the display.

Since neutral density filters absorb a substantial amount of the desired light, the displays using neutral density filters must be capable of producing intense light. This was one of the reasons for developing super bright phosphors for display applications. They increase the cost, however.

Another kind of display devices utilizes a plasma-generated ultraviolet light, which hits the phosphors and generate visible light for the display. In such plasma displays, still under current development by display manufacturers, the phosphors still do not have high enough brightness. Therefore, neutral density filters cannot be used for plasma display applications since they will reduce the brightness still further. Instead, very expensive circular polarizer-based contrast enhancing filters are being used.

Thus, there is a need in the industry to have some device or mechanism to reduce the reflected light from color CRTs and other displays such as plasma displays and the like without significantly sacrificing the brightness and resolution of the image.

Pending U.S. patent applications, Serial No. 08/ 753,349, filed November 25, 1996, and Serial No. 08/------ filed June 9, 1997, disclose a band pass filter for contrast enhancement of a color display. The filter comprises a plurality of dyes and a polymer matrix, wherein the dyes are adapted to substantially selectively transmit predetermined primary color wavelengths of an electromagnetic visible spectrum as well as to selectively absorb wavelengths other than the predetermined primary color wavelengths. The filters disclosed in that pending application are capable of being affixed to a monitor surface

or act as a free-standing device. There may, however, be occasions when the monitor itself may be desired to act as a filter. This could be the case irrespective of whether the monitor is made of glass or plastic. For example, a CRT may utilize a glass monitor, while a flat panel display may be made from a suitable plastic material. There may be occasions when such monitors may themselves be required to filter out undesired wavelengths, increase the contrast of the images and increase the color gamut of their output.

It is, therefore, an object of this invention to provide a display monitor with a built-in filter for color displays to reduce light reflected off such displays.

It is an additional object of this invention to provide a display monitor which enhances the contrast of images without significantly sacrificing the brightness of the image therefrom.

It is a further object of this invention to provide a display monitor with a built-in spectrally tuned multiple bandpass filter for color displays, specifically matched to the three primary colors, namely red, green, and blue.

Other objects and advantages of this invention will be apparent to those skilled in the art from the accompanying description and examples.

Brief Description of the Drawings

The present invention is described in view of the description below as well as with the enclosed **Fig. 1**, **Fig. 2** and **Fig. 3**. **Fig. 1** displays a typical reflectivity of a CRT color phosphor screen. **Fig. 2** displays the phosphor emission spectrum of a PAL ("Phase Alternating Line") system specified in European standard. **Fig. 3** shows the color space

as an (x,y)-Chromaticity diagram for the PAL system calculated both with and without the inventive substrate as a part of monitor.

Summary of the Invention

One or more of the foregoing objects are achieved by the provision in the present invention of a display monitor with a built-in spectroscopically tuned multiple bandpass filter. The filter is integrally incorporated into the monitor and enhances the contrast of the image as well as enlarges the color space without significantly affecting the brightness and resolution of the image. The monitor thus comprises a glass or a suitable plastic substrate with one or more optically absorbing materials- dyes, pigments, metals, semimetals and the like- which are present in the glass or the plastic substrate matrix as small particles (typically less than or equal to 1μm in diameter). If the substrate comprises dye or dyes in a plastic matrix, then instead of being present as particles the dye or dyes may be blended in or dissolved in or absorbed into the plastic film. The absorbing materials are adapted to substantially selectively transmit predetermined primary color wavelengths of an electromagnetic spectrum as well as to selectively absorb wavelengths other than said predetermined primary color wavelengths. The word "spectrally tuned" refers to substantial selective transmission (at least 50 %) of the predetermined primary colors; the word "transparent" refers to at least 70% transmission of light of the electromagnetic spectrum which in the common case such as television display devices such as CRT, plasma displays and the like, is the visible light. In such a case, the primary colors are red, green and blue. Suitable plastics are described below. In other words, the invention discloses a spectrally tuned multiple bandpass glass or

plastic filter as a substrate for display monitor, specifically matched to the three primary colors, i.e., red, green, and blue.

Additionally, the present inventive substrate for display monitor with a built-in bandpass filter allows one to expand the color gamut by adjusting the spectral bandwidth of the band pass windows in the respective wavelengths, thereby allowing more vivid and realistic colors on the CRT's. This is a significant improvement over current CRT technology.

Still additionally, if one so desires, one may deposit a suitable antireflection coating on top of the inventive display monitor surface. In such a case, the antireflection coating is chosen as not to affect the integrity of the monitor physically, chemically and optically. Suitable antireflection coatings are described, for example, in U.S. Patent 5,178,955.

In one illustration, a set of suitable pigments is mixed into a molten glass pool that is suitable for manufacturing the CRT front face plate and the mixture is converted into a glass monitor containing the pigments in it by known processes. The front surface of the display monitor produced from this glass pool absorbs preferentially the unwanted wavelengths with minimal absorption of the primary colors. Thus, the transmitted light is sharper and richer in the primary colors. Improvements in the color transmission in the primary colors to 20% and above compared to neutral density filters are obtained, while decrease in the transmission of the unwanted wavelengths to the extent of 50% is obtained.

Description of the Invention

In one embodiment, the present invention discloses a display monitor incorporating a spectroscopically tuned multiple bandpass filter (notch filter) which substantially increases the transmission of the primary colors from a color display device while substantially reducing the reflected light of the non-primary colors, thereby improving the contrast and color gamut of the image for the viewers. The monitor comprises a suitable substrate containing a set of suitable absorbing materials that sufficiently absorb the non-primary colors, without significantly affecting the primary colors. Sufficient absorption is generally over 20%, preferably over 50% and typically over 80%. Suitable substrates are in general transparent glasses or polymeric materials depending on the types of the desired display.

Contrast from a display device screen is generally defined by the term 'contrast ratio'. Contrast ratio C is commonly defined by Equation (1):

$$C = I_s/I_b \qquad (1)$$

where I_s and I_b are respectively the weighted spectroscopically averaged display light source intensity and the weighted spectroscopically averaged ambient light intensity reflected from the display. The term 'weighted average' means the use of human eye spectral sensitivity function as a weighting function. For displays with no contrast enhancing function, Equation 1 becomes

$$C_o = I_p/I_oR \qquad (2)$$

where Co is the contrast without any contrast enhancing functionality in the display substrate, I_p and I_o are respectively the weighted spectroscopically averaged display light source intensity (e.g., phosphor emission intensity), and ambient light intensity without any contrast enhancing functionality, and R is reflectivity from the display

phosphor layers, i.e., the rear surface of the display substrate. By definition, then

$$I_s = I_pT \quad (3)$$

and

$$I_b = I_oT^2R \quad (4)$$

where T is the weighted spectroscopically averaged transmittance of the display substrate and I_o is the weighted spectrocopically averaged ambient light intensity impinging on the display surface. Equation 1 can now be rewritten as

$$C = I_pT/I_oT^2R = C_o/T \quad (5)$$

As can be seen, C can be increased by making I_b arbitrarily small for a given display system. In other words, if a display is viewed in total darkness (I_b very small), one can have very high contrast, making it very difficult to compare two different displays without using an identical condition. Display industries are therefore making an attempt to use a standardized ambient light condition in comparing display performance. Similarly by increasing I_s, one can improve C. In fact, display industry is working hard to increase I_s. Since I_s and I_b are independent of contrast enhancing devices, normalized contrast Φ and display intensity ψ, and the figure-of-merits Γ are generally defined in order to compare the performance of contrast enhancing functions as given in Equations (6), (7) and (8):

$$\Phi = C/ C_o \quad (6)$$

$$\psi = I_s/I_p \quad (7)$$

and

$$\Gamma = \psi\, \Phi \quad (8)$$

From Equations from 1 through 4, it can be shown that $\Phi = 1$, $\psi = 1$ and $\Gamma = 1$. It can be further shown that for an ideal neutral density or similar filters,

$$\Phi = 1/T; \qquad \psi = T; \qquad \Gamma = 1 \qquad (9)$$

$\Gamma = 1$ means that there is no improvement in the figure-of merits with the commonly used neutral density filters. Thus, the neutral density filters do not improve the real performance, but provide a trade-off between display brightness and contrast. In other words, they offer contrast enhancement at the expense of image brightness. Thus, for example, for a 50% ($T = 0.5$) absorptive neutral density filter, contrast may be doubled, i.e. $\Phi = 2$ and $\psi = 0.5$. But there is 50% absorption of display intensity.

With the inventive display substrate, Equation (4) can rewritten as

$$I_b = I_o T^2 RB \qquad (10)$$

where B is the bandwidth of the filter function. If one assumes that transmittance goes to zero percent outside of the pass band of the filter, and the transmittance is 100 % within the pass bands and that the display phosphor emission spectra are completely contained within this pass bandwidth of the filter, equation (9) can now be written for the inventive substrates with spectrally tuned built-in bandpass filter function as:

$$\Phi = 1/TB; \qquad \psi = T; \Gamma = 1/B \qquad (9)$$

This new equation (9) reveals that there are two independent variables for optimization of the filter performance for the inventive display substrate with a built-in spectroscopically selective filter. There exists a fundamental gain in figure-of-merits as shown in the above equation.

Although by making B arbitrarily small one can increase Γ indefinitely, in reality, this is not always true, because by making B smaller than the spectral width of the display emission spectrum, we may reduce the display intensity itself. As shown below the inventive filter's performance depends on the spectral width of the display emission spectrum.

The monitor using the inventive substrate is capable of performing significantly better for both the NTSC ("National Television Systems Committee") and the PAL ("Phase Alternating Line") system specifications. The reflectivity of a CRT color phosphor screen is shown in **Fig. 1**, and the PAL system specification of the phosphor emission spectrum is shown in **Fig. 2**. The spectral characteristics of the inventive filter for the PAL specification, as shown by computer simulation, is also shown in **Fig. 2**, which shows that the calculated figure-of-merit Γ goes up at least 1.3 times, while the brightness loss is only about 40%. The inventive filter has the following values: $\Phi = 2.0$ and $\psi = 0.6$. This is a good improvement over the ideal neutral density filter performance. For the NTSC system, due to narrower green phosphor emission spectrum, the improvement in the figure-of-merit Γ is expected to be at least two-fold. In this case, the calculated numbers for the inventive filter are: $\Phi = 2.4$ and $\psi = 0.8$. This represents about a 100 % improvement in the brightness over the neutral density filters for the same contrast enhancement. The details below illustrate the inventive filters and the process of making them.

In another embodiment, the invention discloses spectroscopically tuned glass filters as monitor for display applications. The filters comprise suitable absorbing materials in a display glass substrate matrix. Suitable absorbing materials are those which

selectively absorb undesired wavelengths without significantly absorbing the desired wavelengths. For example, absorption of yellow (about 590 nm) leads to output of blue (about 450 nm). The desired wavelengths correspond to the three primary colors; red, blue and green. Suitable absorbing materials are described below.

Another embodiment discloses spectroscopically tuned plastic filters as monitor substrates for display applications. The filters comprise suitable absorbing materials or dyes in a display polymeric substrate matrix. Suitable absorbing materials and dyes are those which selectively absorb undesired wavelengths without significantly absorbing the desired wavelengths. The desired wavelengths correspond to the three primary colors: red, blue and green.

Yet another embodiment of the present invention discloses a process for preparing the spectrally tuned glass display monitor. A set of suitable absorbing materials is directly incorporated into a suitable glass display substrate to sufficient concentration in order to effect sufficient absorption of the undesired wavelengths in the transmitted light. Sufficient absorption is generally over 20%, preferably over 50% and typically over 80%. In one illustration, a set of suitable pigments is mixed into a molten glass pool that is suitable for manufacturing the CRT front face plate and the glass monitor containing the pigments in it is manufactured by known processes. The front surface of the monitor produced from this glass pool absorbs preferentially the unwanted wavelengths with minimal absorption of the primary colors.

Another way of manufacturing the spectrally tuned substrates for monitors is by using a suitable staining process such as, for example, stained glass manufacturing process which is well known in the glass industry.

In an illustration, a set of carefully chosen sub-micron metallic particles of gold with diameters on the order of 100 Angstroms are dispersed into molten glass pool with the particle concentration in the range of 1 to 100 ppm. The concentration depends on the thickness of the glass to be made. Curved front plate of CRT and flat glass sheets for plasma displays with thickness of a few millimeters are made. Spectral tuning is achieved by the size distribution of gold particles. Alternatively, a thin layer of metallic films with thickness on the order of 100 Angstroms can be deposited on the surface of both type of substrates.

For preparing a plastic monitor/filter, the absorbing materials or dyes may be diffused into a suitable polymeric substrate as a film. For example, the process to prepare dye-in polyethylene terephthalate film is well known commercially. Suitable polymeric substrates are optically transparent polymers such as, for example, polyesters (e.g., polyethylene terephthalate or PET, polybutylene terephthalate or PBT), polyacrylates, polyolefins, polycarbonate, cellulose acetate, polyvinyl chloride, polystyrene, acrylonitrile-butadiene-styrene ("ABS") and the like. Thus, a PET film of suitable thickness for a monitor may be treated with a solution of suitable dyes in a solvent that dissolves the dyes and transports them into the PET film without deleteriously affecting the integrity of the polymer film. Alternatively, the selected dyes may be mixed with the PET resin and the mixture may then be cast or extruded or injected or treated by similar such methods to form a PET film containing the dyes therein. Such methods and modifications are well known to those skilled in the art of polymer processing.

The inventive contrast enhancing substrates offer an additional advantage over the conventional devices for the contrast enhancement. The color gamut, which is a rough calculation for total color space, is significantly improved with the inventive substrates, as shown by calculations and computer simulation. The images thus are sharper and brighter. **Fig. 3** shows the color space for the PAL system both with the inventive monitors and with a conventional monitor with neutral density filter. The color space is enlarged by as much as 50 % more than in the typical PAL CRT. The color coordinates of the CRT with conventional substrates are (0.62, 0.33), (0.28, 0.58) and (0.16, 0.06). With the inventive monitors, the same coordinates are expanded to (0.69, 0.29), (0.15, 0.77) and (0.17, 0.03) respectively, thus demonstrating that the inventive substrates not only enhance the contrast of the images but also offer much brighter and sharper primary colors. Such advantages enhance the utility of the CRT as well as the other display devices such as plasma displays and the like, when the inventive monitors are part of the display.

Suitable metals for the glass include, for example, gold, silver, copper, aluminum and nickel as well as alloys such as, for example, bronze. Examples of suitable semimetals include arsenic, antimony, bismuth, allemontite, selenium, tellurium, La_3Se_4, GeTc, SnTc and $SrTiO_3$. Suitable inorganic colorants include commercially available materials such as, for example, Prussian Blue, lead chromate, chromium oxide, silver chromate, ultramarine blue, manganese violet, cobalt violet, cadmium orange, cadmium sulfoselenide, nickel complexes, molybdenum oxide, iron oxide, cobalt salts, cerium salts, nickel salts, copper salts and the like. Suitable organic pigments and dyes include flavanthrone, rhodamine, Victoria Blue, Methyl Violet,

Persian Orange, Pigment Yellow, Pigment Red, Azo dyes, thioindigo pigments, perylenes, anthraquinones, phthalocyanines, porphyrins, anisidines, disperse dyes, indanthrones, sulfoflavines, vat dyes and the like. The particle sizes suitable in the practice of the invention range generally from 0.01-100 µm. The particle shapes may be spherical, acicular, needle-like, laminar, platy and the like. Suitable glasses include borosilicate glass, sodalime glass, aluminosilicate glass, borate glass, phosphate glass, oxide glasses, chalcogenide glass, halide glass, metallic glass and the like. The concentration of the absorbing material in the glass or polymer matrix is effective enough to result in absorption of over 20%, preferably over 50% and typically over 80% of the undesired wavelengths; sometimes as low as 1 ppm concentration is sufficient to effect such absorption and sometimes one may need concentrations in the order of 1 weight percent of the absorbing material in the matrix.

CLAIMS

What is claimed is:

1. A display monitor with a built-in spectroscopically tuned multiple bandpass pass filter for contrast enhancement of a color display, said monitor comprising a plurality of absorbing materials integrally mixed in a suitable transparent display substrate, wherein said absorbing materials are adapted to substantially selectively transmit predetermined primary color wavelengths of an electromagnetic visible spectrum as well as to selectively absorb wavelengths other than said predetermined primary color wavelengths.

2. The monitor of claim 1, wherein said primary color wavelengths correspond to the red, green and blue wavelengths of visible spectrum.

3. The monitor of claim 1, further containing an antireflection layer thereon.

4. The monitor of claim 1, wherein said absorbing materials are organic or inorganic.

5. The monitor of claim 1, wherein said transparent display substrate is selected from the group consisting of soda lime glass, borosilicate glass, aluminosilicate glass, borate glass, phosphate glass, oxide glasses, chalcogenide glass, halide glass, metallic glass and a transparent polymeric material.

6. The monitor of claim 5, wherein said substrate is soda lime glass.

7. The monitor of claim 5, wherein said substrate is borosilicate glass.

8. The monitor of claim 5, wherein said substrate is a transparent polymer.

9. The monitor of claim 9, wherein said polymer is selected from the group consisting of polyester, polyolefin, polyvinyl, acrylonitrile-butadiene-styrene copolymer and mixtures thereof.

10. The monitor of claim 9, wherein said polymer is a polyester.

11. The monitor of claim 10, wherein said polyester is polyethylene terephthalate.

12. The monitor of claim 10, wherein said polyester is polybutylene terephthalate.

13 The monitor of claim 4, wherein said absorbing materials are organic.

14. The monitor of claim 4, wherein said absorbing materials are inorganic.

15. The monitor of claim 13, wherein said organic material is selected from the group consisting of flavanthrone, rhodamine, Victoria Blue, Methyl Violet, Persian Orange, Pigment Yellow, Pigment

Red, Azo dye, thioindigo pigment, perylene, anthraquinone, phthalocyanine, porphyrin, anisidine, disperse dye, indanthrone, sulfoflavine, vat dye and mixtures thereof.

16. The monitor of claim 14, wherein said inorganic material is selected from the group consisting of gold, silver, copper, bronze, nickel, aluminum, Prussian Blue, lead chromate, chromium oxide, silver chromate, ultramarine blue, manganese violet, cobalt violet, cadmium orange, cadmium sulfoselenide, nickel complex, molybdenum oxide, iron oxide, cobalt salt, cerium salt, nickel salt, copper salt and mixtures thereof.

17. The monitor of claim 16, wherein said absorbing material is gold.

18. The monitor of claim 1, wherein said absorbing material has particle sizes in the range 0.01-100 μm.

19. A process of preparing a glass monitor with a built-in band pass filter for contrast enhancement of a color display, said process comprising: (a) preparing submicron metallic and/or semi-metallic particles with a particle size distribution in the range 0.01-0.1 μm; (b) mixing said particles into a molten glass pool in concentration in the range 1-100 ppm, and (c) forming the glass monitor from the mixture in step (b).

20. The process of claim 19, wherein said metallic particle in step (a) is gold.

21. A process of preparing a plastic monitor with a built-in band pass filter for contrast enhancement of a color display, said process comprising: (a) preparing a mixture of organic dyes with a particle size distribution in the range 0.01-0.5μm wherein said dyes are adapted to substantially selectively transmit predetermined primary color wavelengths of an electromagnetic visible spectrum as well as to selectively absorb wavelengths other than said predetermined primary color wavelengths; (b) mixing said particles with a polymer resin suitable to be molded into said monitor in concentration in the range 1-1000 ppm, and (c) forming the monitor from the mixture in step (b).

22. The process of claim 21, wherein said polymer resin is a polyester.

23. The process of claim 22, wherein said polyester is polyethylene terephthalate.

FIG. 1

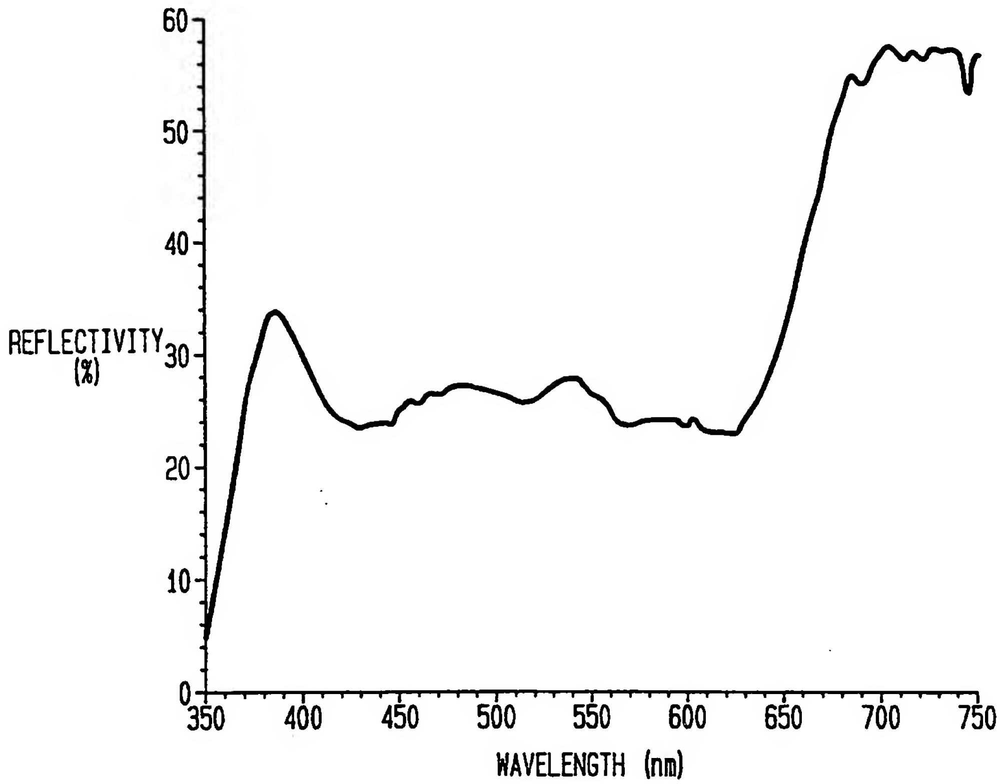

REFLECTIVITY (%)
0
10
20
30
40
50
60
350
400
450
500
550
600
650
700
750
WAVELENGTH (nm)

FIG. 2

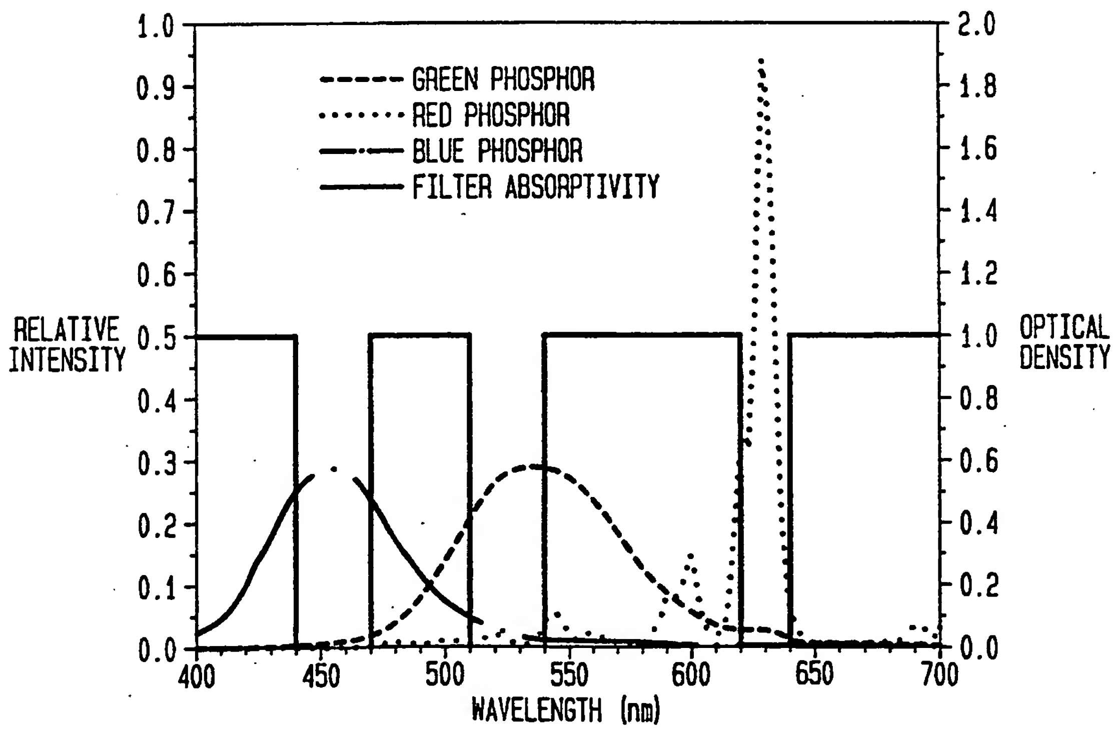
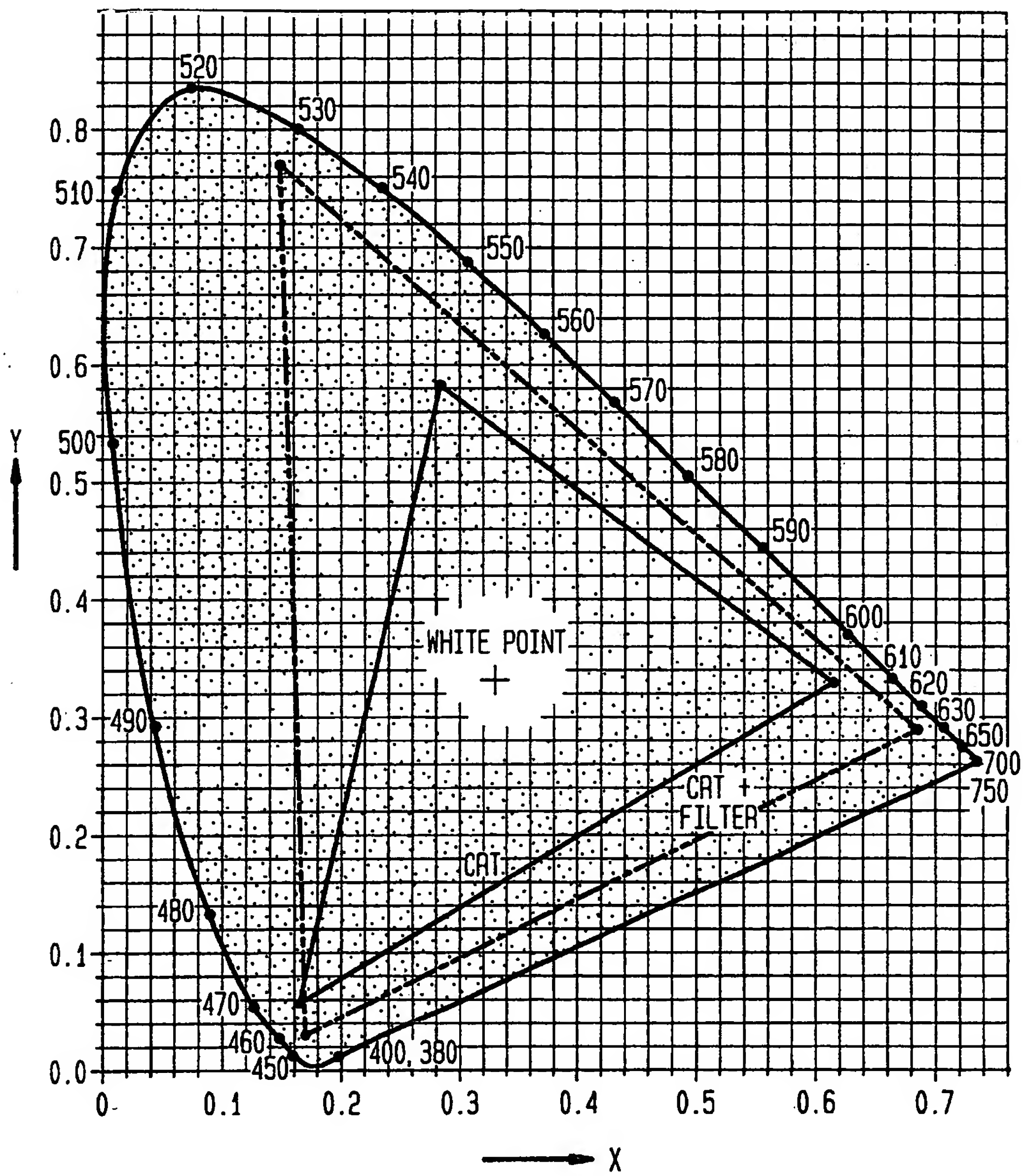

GREEN PHOSPHOR
RED PHOSPHOR
BLUE PHOSPHOR
FILTER ABSORPTIVITY
RELATIVE INTENSITY
OPTICAL DENSITY
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
400
450
500
550
600
650
700
WAVELENGTH (nm)

FIG. 3


520
530
540
550
560
570
580
590
600
610
620
630
650
700
750
510
500
490
480
470
460
450
400, 380
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Y
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
X
WHITE POINT
CRT
CRT + FILTER

[redacted]

International Application No
PCT/US 98/10776

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01J29/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01J C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 504 616 A (UEHARA HIROSHI ET AL) 12 March 1985 see claims 1-18 ---	1,4,5,8, 13,14,21
X	GB 2 093 268 A (MITSUBISHI ELECTRIC CORP) 25 August 1982 see page 7, line 67 - line 105 ---	1,2,4
X	US 4 086 089 A (SEWARD III THOMAS PHILIP ET AL) 25 April 1978 see column 5, line 25 - line 64; claim 1 ---	1,19
X	DE 15 14 825 A (TELEFUNKEN) 14 August 1969 see claims 1,2 ---	1
X	EP 0 041 339 A (MITSUBISHI ELECTRIC CORP) 9 December 1981 see claims 1-7 --- -/--	1,2,4

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 September 1998	02/10/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Van den Bulcke, E

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 98/10776

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4504616 A	12-03-1985	JP 1869692 C	06-09-1994
		JP 59217705 A	07-12-1984
		JP 59023306 A	06-02-1984
		DE 3375150 A	11-02-1988
		EP 0100519 A	15-02-1984
GB 2093268 A	25-08-1982	JP 1509667 C	26-07-1989
		JP 57134850 A	20-08-1982
		JP 63059502 B	18-11-1988
		JP 1509668 C	26-07-1989
		JP 57134851 A	20-08-1982
		JP 63059503 B	18-11-1988
		DE 3204895 A	30-09-1982
		US 4728856 A	01-03-1988
US 4086089 A	25-04-1978	NONE	
DE 1514825 A	14-08-1969	NONE	
EP 0041339 A	09-12-1981	JP 56168324 A	24-12-1981
		JP 57061239 A	13-04-1982
		US 4405881 A,B	20-09-1983
FR 2426974 A	21-12-1979	US 4177399 A	04-12-1979
		DE 2920830 A	29-11-1979
		GB 1604928 A	16-12-1981
		JP 54154262 A	05-12-1979
EP 0613167 A	31-08-1994	JP 6310061 A	04-11-1994
		US 5754001 A	19-05-1998
EP 0350995 A	17-01-1990	US 4937661 A	26-06-1990
		DE 68915628 D	07-07-1994
		DE 68915628 T	22-12-1994
		JP 2078139 A	19-03-1990
WO 9013906 A	15-11-1990	US 5121030 A	09-06-1992
		CA 2032166 A	04-11-1990
		DE 69022048 D	05-10-1995
		DE 69022048 T	02-05-1996

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 426 974 A (WESTINGHOUSE ELECTRIC CORP) 21 December 1979 see claim 1	1
X	G. BAN ET AL.: "enhancing the brightness capability of color-tv receivers through the use of a spectrally selective tinted glass" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, vol. 116, no. 4, April 1969, pages 531-534, XP002078007 see page 531	1
A	EP 0 613 167 A (SONY CORP) 31 August 1994 see claim 1	1
A	EP 0 350 995 A (PHILIPS NV) 17 January 1990 see claim 1	1
A	WO 90 13906 A (HONEYWELL INC) 15 November 1990 see claim 1	1
A	US 4 581 561 A (PALAC KAZIMIR) 8 April 1986 see claim 1	1
P,A	WO 98 23980 A (HOECHST CELANESE CORP) 4 June 1998 cited in the application see claim 1	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int [illegible]ional Application No
PCT/US 98/10776

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9013906 A		EP 0471007 A JP 4504924 T	19-02-1992 27-08-1992
US 4581561 A	08-04-1986	NONE	
WO 9823980 A	04-06-1998	NONE	

[redacted]